IMPROVED ELEMENT FOR FORMING GROUND COVERING, RESTRAINING AND REINFORCING STRUCTURES

The present invention relates to the sector of ground covering, restraining and reinforcing structures, for instance for the stabilisation of slopes, embankments and the like.

The applicants have in the past developed various structures of the type described above which have proved particularly appropriate and effective. For instance, document EP 1012406 in the name of the applicants discloses a structure formed by a framework of wire netting of the double twist type, folded to form a structure with a base wall, a front wall and a rear wall. The front wall of wire netting is reinforced with a further panel of electrically welded wire netting. A geosynthetic layer on the front wall makes it possible to provide "green" walls and can be used for the growth of vegetation which helps to stabilise the slope.

Although the structures described above have demonstrated that they can effectively perform their task of stabilisation, their construction on site requires skilled workers and specific equipment. When stabilising steep slopes, for instance, a scaffolding has to be erected at the front of the works in order to enable access to the structure from the front wall side in order to carry out the manual folding of the wire netting and thus produce the upper wall section. During this folding, moreover, the metal structure of the netting has to be deformed at the fold line, making site installation operations laborious and in some cases not very precise.

The object of the present invention is to resolve the above-mentioned problems by means of an improved element for forming ground covering, restraining and reinforcing

structures which can be correctly installed on site in a simple manner, possibly by relatively unskilled workers, and which does not, moreover, require the use of specific equipment or the erection of scaffolding at the front of the works.

A further object of the invention is to provide an improved element which is simple and economic to produce, can be readily transported from factory to site and also has a strength and a reliability at least equivalent to those of the elements of known type.

In order to achieve the above-described objects, the present invention relates to an improved element having the characteristic features set out in the following claims.

Further characteristic features and advantages are set out in the following detailed description of a preferred embodiment, given purely by way of non-limiting example, and made with reference to the accompanying drawings, in which:

- Fig. 1 is a perspective view of an improved element of the present invention, in a ready-for-use configuration;
- Figs. 2 to 6 show the successive stages of use of the improved element of Fig.1;
- Fig. 6a is a variant of the end-use configuration of Fig. 6;
- Fig. 7 is a section through a restraining wall or reinforced slope comprising superimposed layers formed by a plurality of elements of Fig. 1.

With reference to Fig. 1, an element 1 for forming ground covering, restraining and reinforcing structures of the present invention comprises a front wall F, a lower wall L and an upper wall U. The front wall F comprises a front panel 2 with two opposite edges 3, 4 connected in an articulated manner to a lower panel 5 of the lower wall L and an upper

panel 6 of the upper wall U respectively. The panels are preferably of wire netting and the front panel 2 can in particular be made from electrically welded wire netting, for instance of the square mesh type, while the lower and upper panels 5 and 6 can be made from wire netting preferably, but not exclusively, of the double twist and hexagonal mesh type. The articulated connections between the panels are preferably made at the factory by means of mechanised metal staples, metal ties or other known connection means.

A covering layer 7 of geosynthetic material or bio-matting may be secured where appropriate to the front panel 2 and may be extended to cover all or part of the lower and upper panels 5 and 6 as well. Brackets 8, preferably but not exclusively of triangular shape, are also connected to the front panel 2. The brackets 8 may also be in the form of bars secured or hooked to the front panel 2 and/or the lower panel 5. In the case of the triangular brackets 8 shown in the drawings, only the front side 9 of each bracket is connected in an articulated manner to the front panel 2 so that the brackets 8 may be folded against the front panel 2, as shown by the dot-dash line 10 in Fig. 1, for more convenient transportation of the element 1 in a flat form from the factory to the site.

The preferred configuration for transportation of the element 1 is shown in Fig. 2, in which the front panel 2 and the upper panel 6 are folded onto the lower panel 5 whose dimensions are normally larger. It will be appreciated that, depending on the particular dimensions of the netting panels which form the element 1 and/or the convenience of packaging of the elements 1, as well as the type and dimensions of the vehicles used to transport these elements, that the panels may be folded in an alternative way, for instance in zigzag form, in which the upper panel 6 is placed on the front panel 2 as shown by the dashed arrow 11 of Fig. 2.

After placing the element 1, and in particular the lower panel 5, on the section of ground to be reinforced, the front panel 2 is raised, as shown in Fig. 3, until it reaches a position inclined to a greater or lesser extent with respect to the lower panel 5. The front panel is held in position by the brackets 8 which are oriented so that the ends of a rear side 12 thereof bear on the lower panel 5 and the front panel 2 respectively. It will be appreciated that this object could be achieved by alternative brackets in the form of simple bars as mentioned above. The upper panel 6 may be held manually in the raised position shown in Fig,. 3 or may be placed on the front surface of the front wall 2 by causing it to tilt in the direction of the dashed arrow 13. Obviously, when the element 1 is to be transported to the site in the zigzag folded configuration mentioned above, the upper panel 5 would already be in the above-mentioned position folded on the front surface of the front panel 2.

The ground reinforcing operations continue with the provision of a layer of earth, preferably topsoil, at the rear of the front panel 2, as shown in Fig. 4. The layer of earth 14 is preferably arranged so that it has, in cross-section with respect to the layers of panels of the element 1, a substantially triangular profile. If the upper panel 6 is not too high, and in particular substantially corresponds to or is lower than the height of the front panel 2, is it possible to tilt this upper panel 6 in the direction of the dashed arrow 15 of Fig. 4 until it is alongside the rear flank of the layer of earth 14, as shown by reference numeral 16 in Figs. 5 to 7. As an alternative, it is possible to place the upper panel 6 on a further layer of earth 17, preferably a structural embankment, which is placed alongside, as shown in Fig. 6, the first layer of earth 14 to complete one of the plurality of layers 18 of the reinforcing works shown overall in Fig. 7 and formed by a sequence of superimposed elements 1. In this latter case, the final configuration of the

element 1 bears the conventional "C"-shaped configuration, in which the lower and upper panels 5 and 6 are substantially parallel.

Many variants are possible with respect to the preferred embodiment described above. For instance, the front, lower and/or upper walls F, L and U may be made from a plurality of wire netting panels connected to one another rigidly or in an articulated manner. For instance, the upper wall U could be divided into two portions comprising at least two wire netting panels 6a, 6b connected together and articulated along a common edge 20, shown diagrammatically in dot-dash lines in Fig. 6a, substantially parallel to the edges 3, 4 of the front panel 2. This makes it possible to provide the layer of earth 14 with a configuration, in cross-section with respect to the layers of panels of the element 1, with a substantially trapezoidal profile at whose apex the panel 6a is placed, while the panel 6b is placed on the inclined side opposite to the front wall F so that it can then be incorporated in the earth 17 provided subsequently. Obviously, in the case in which the upper wall U is placed on the earth in a position substantially parallel to the lower wall L, the configuration of the layer of earth 14 may be triangular or trapezoidal.

The embodiments and structural details of the invention may obviously be widely varied from those described and illustrated, without prejudice to the principle of the invention and without thereby departing from the scope of the present invention.